Chapter Five: Reasonably Foreseeable Effects of the Licensing and Subsequent Activity

Contents

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A. Fiscal Effects

This section discusses the fiscal effects, both statewide and local, of licensing activities and subsequent oil and gas revenues. The discussion illustrates the dependency of Alaska's economy on oil and gas. The Copper River basin exploration licensing proposal is the first of its kind in Alaska, so there is no history of related fiscal effects. Similar to lease sales, licensing will generate income for state government and, therefore, have numerous effects throughout the state. Some of the possible benefits could include increased revenue sharing, creation of new jobs, and indirect income multiplier effects.

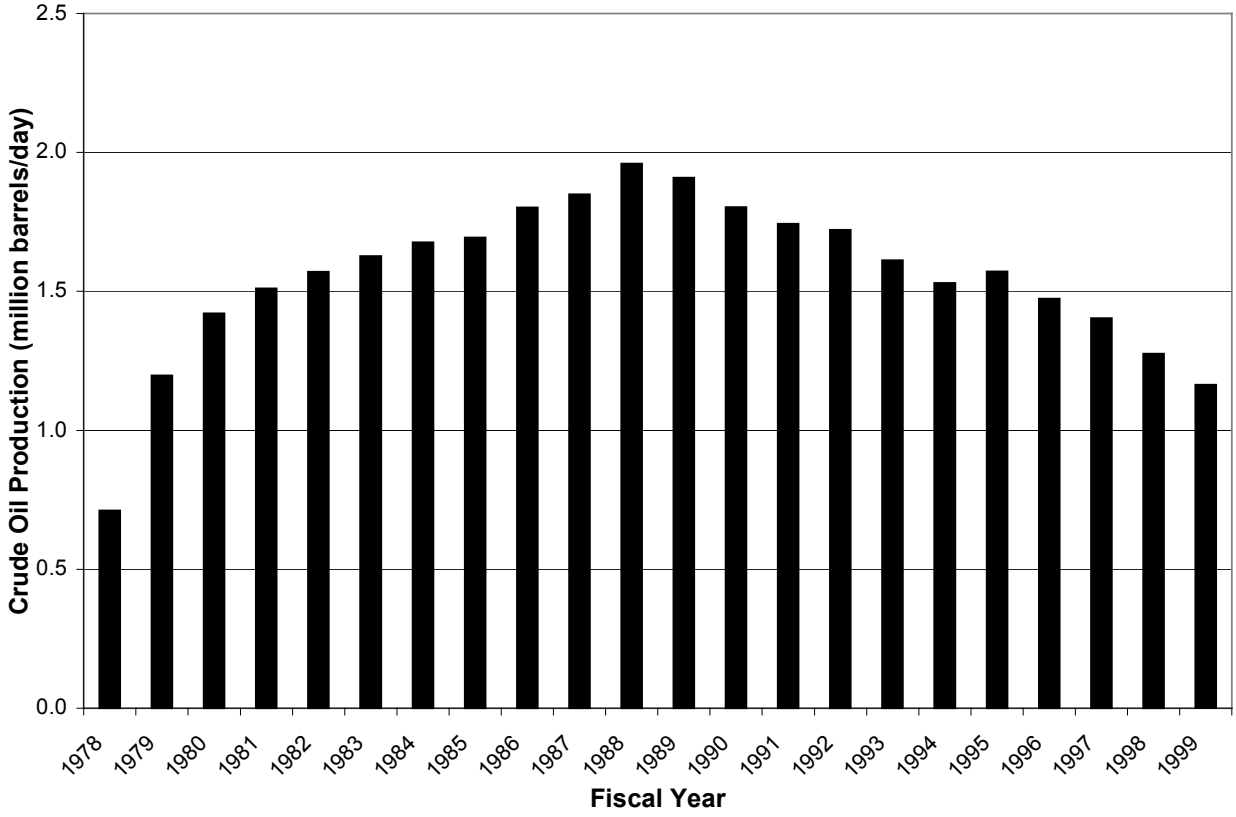
1. Statewide

Alaska's economy depends heavily on revenues related to oil and gas production, and the government spending that results from those revenues. The following statistics from the Alaska Department of Revenue (ADOR, 1999) and Alaska Department of Natural Resources (ADNR, 1999) illustrate various ways in which the licensing program could generate income to state government.

- License Fees. Rather than an up-front bonus payment to the state, as in conventional leasing, an applicant for a license will bid direct exploration expenditures. The recipient of the license then posts an annual bond in the amount of the work commitment divided by the remaining term of the license and pays a $1.00 per acre license fee. Because this is a new supplement to conventional leasing, no historical data is available on past license fee revenue.
- Rentals. With exploration licensing, the state does not receive direct revenue until the licensed area is converted into oil and gas leases. Once a license is converted into an oil and gas lease, each lease requires an annual rental payment of $3.00 per acre to the state.
- Royalties. Royalties represent the state's share of the production as the mineral interest owner. Royalty payments amounted to $480.5 million in revenue in fiscal year (FY) 1999, and are projected to total $961.2 million in FY 2000. Royalty rates for this license area are set at 12.5 percent.
- Production Taxes. Production taxes must be paid by producers on all taxable oil and gas produced from each lease or property in the state. The taxes are paid on a percentage of gross value basis. Oil and gas severance taxes were $652.7 million for FY 1999, and are projected to be $358.6 million in FY 2000.
- Income Taxes. Income taxes must be paid by all corporations in Alaska for all taxable income derived from sources within the state, and most producers and transporters of oil and gas in Alaska are corporations. Special provisions apply to apportioning total income worldwide for corporations involved in either the production or transportation of oil and gas. Corporate income taxes generated $145.1 million in FY 1999, and are expected to generate $145.0 million in FY 2000.
- Oil & Gas Property Taxes. An annual tax is levied each year on the full and true value of property taxable under AS 43.56. This includes exploration property, production property, pipeline transportation property. Property Taxes amounted to $48.8 million in FY 1999, and are projected to be $46.8 million in FY 2000.

These revenues together constituted approximately 75 percent of the state's general fund unrestricted revenue in FY 1999. Figure 5.1 shows crude oil production volumes for FYs 1978 through 1999, and Figure 5.2 shows state revenue from subsequent oil and gas royalties for 1959 through 1998. These figures illustrate the dependency of Alaska's economy on the oil and gas industry.

Figure 5.1 Statewide Crude Oil Production Volumes, 1978-1999

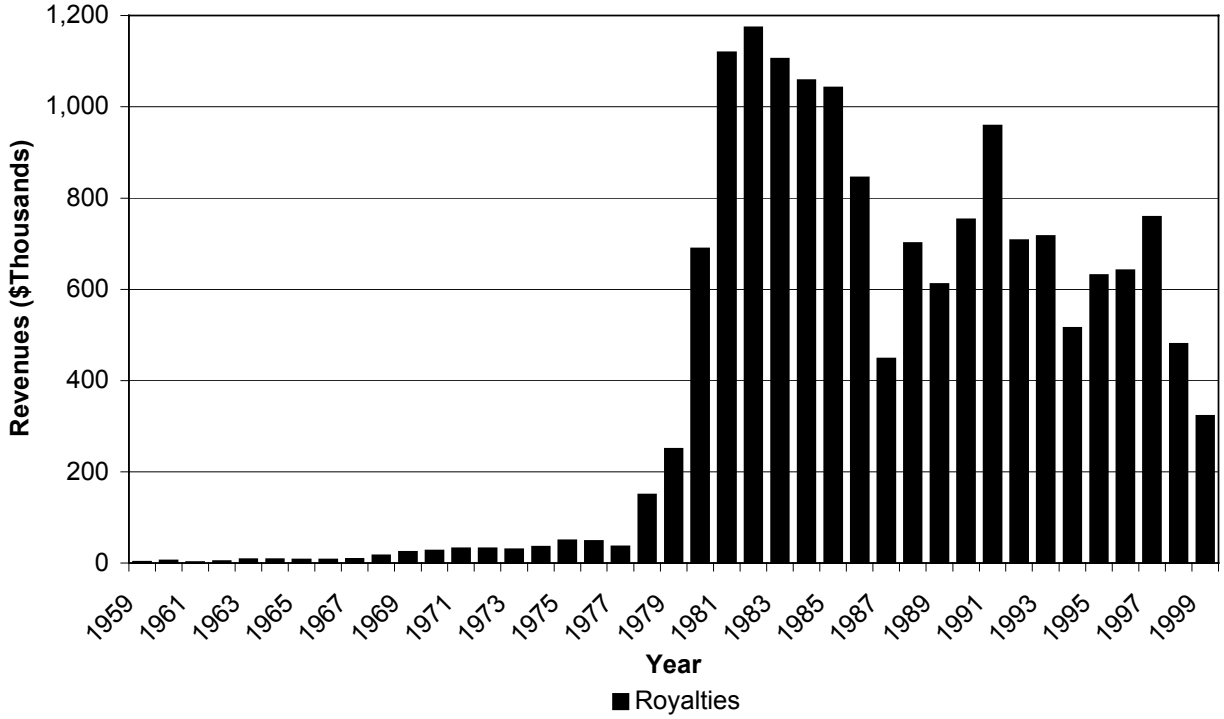


Source: ADOR, 2000.

In addition to direct contributions to the state's general fund, oil and gas production results in contributions to the Alaska Permanent Fund, which was established in 1976. In 1980, legislators determined that 50 percent of all revenue generated by oil and gas activities would be placed in the Permanent Fund, and the first dividends were issued to Alaskans in 1982. All qualified Alaskans that apply receive an annual dividend from the earnings of the Permanent Fund, regardless of income or socioeconomic status. Figure 5.3 illustrates the Permanent Fund Dividend that was disbursed to qualified Alaskans from 1982 through 1999.

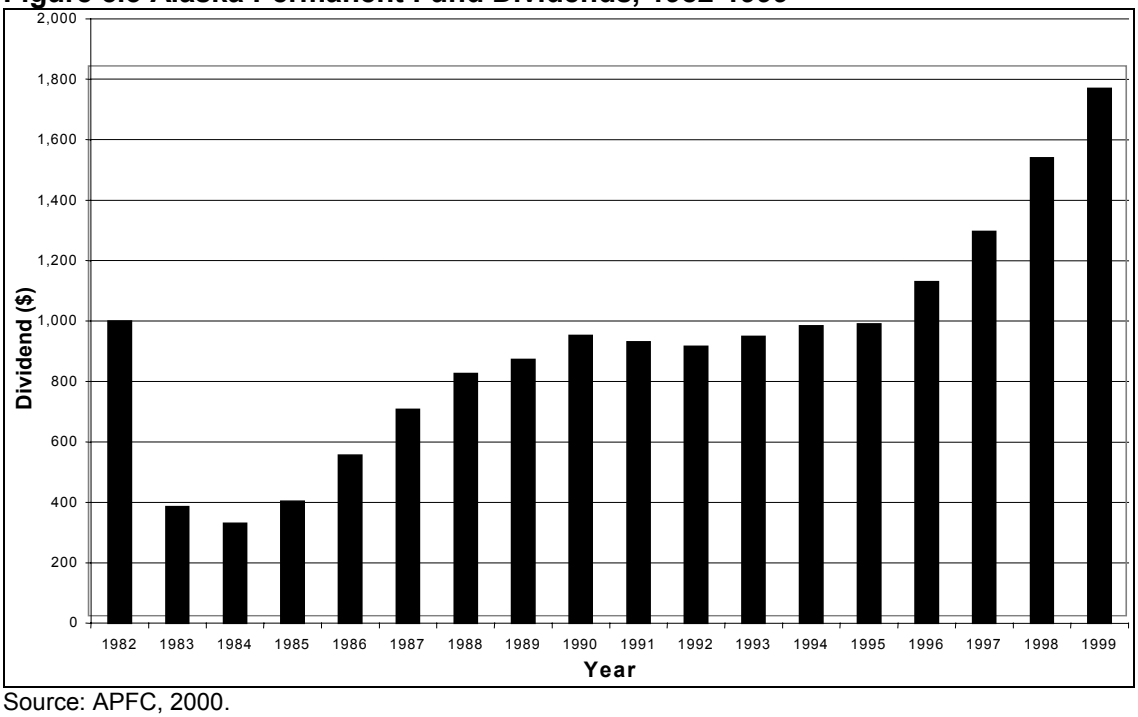
The Permanent Fund continues to support Alaska families and the state economy. Since the program's inception, more than $7.7 billion in dividends have been disbursed (APFC, 1999). In 1998, approximately $869 million was distributed under the program to an estimated 564,085 eligible Alaskans. Every qualified resident received approximately $1,541 in 1998, and $1,769.84 in 1999. As of September 20, 1999, the fund's value stood at $26,417,400,000 (unaudited position - APFC, 1999). The steady growth of the Permanent Fund Dividend over time is a result of significant investment earnings, as well as oil and gas revenue. Figure 5.4 clearly illustrates that, with the decrease in crude oil production volumes, investment earnings have become a much more significant contributor to the steady growth of the Permanent Fund.

Figure 5.2 State Revenues from Oil and Gas Royalties, 1959-1998



Source: ADOR, 2000.

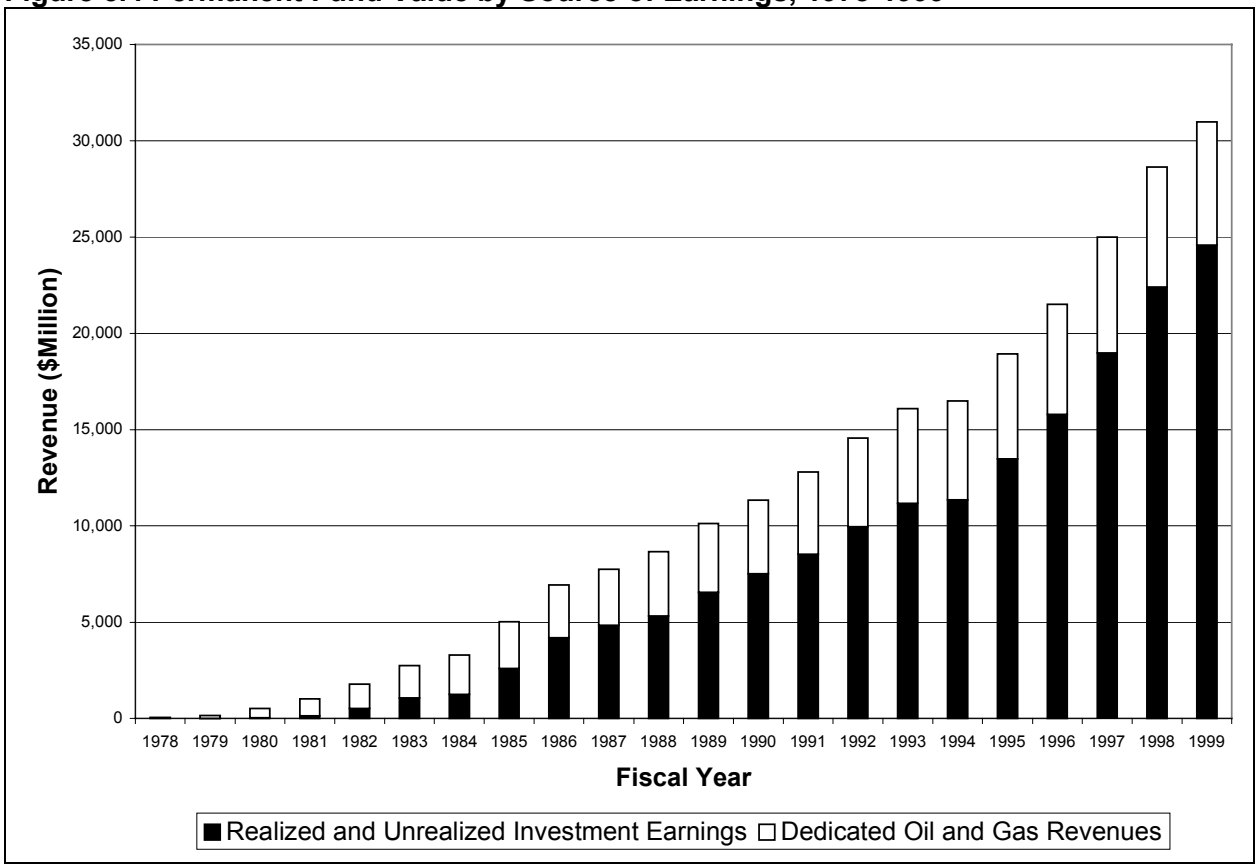
Figure 5.3 Alaska Permanent Fund Dividends, 1982-1999



Source: APFC, 2000.

The numerous total economic effects of spending, including government spending and salaries paid to oil and gas employees, are always greater than the direct effect. An income multiplier is a measure of the indirect effects that result from increased economic activity in an area and represents how money can "trickle down" through the economy. For example, an income multiplier for state government spending has been calculated at 1.35. This translates into an additional $0.35 of income generated when every dollar that Alaskans receive directly from the state is spent in the local economy (UAA, 1990).

Figure 5.4 Permanent Fund Value by Source of Earnings, 1978-1999

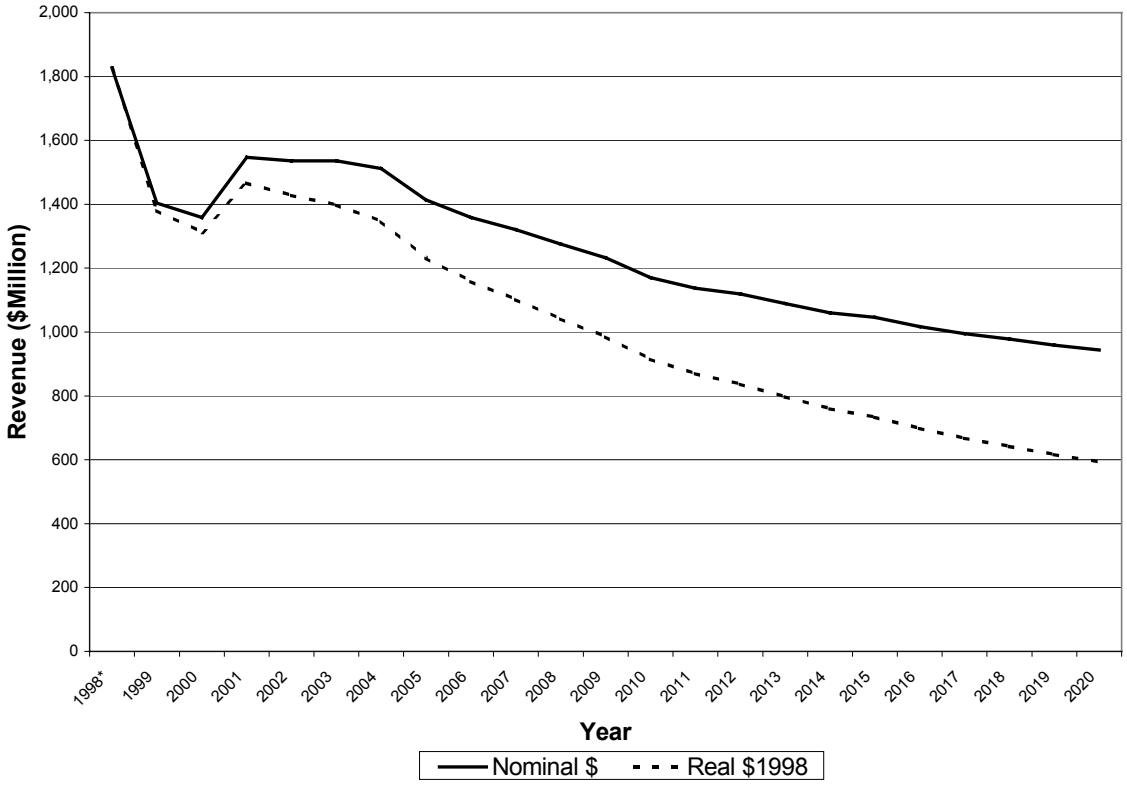


Source: APFC, 1999.

This income multiplier can be a very valuable indicator of the general, statewide-indirect effects of government spending. However, on the local level, income multipliers vary across the state. Income multipliers for the smaller, rural communities in the Copper River basin would be significantly smaller than the income multiplier for the Municipality of Anchorage, primarily because money cycles through an urban community faster and more frequently than through a rural community. The income multiplier for the Copper River basin communities is discussed in more detail below.

ADOR projections for the State General Fund unrestricted revenue through 2020 are presented on Figure 5.5. ADOR projects that over the next 20 years there will be a steady decrease in General Fund unrestricted revenue, in part because oil and gas revenue resulting from royalties, bonuses, and rents, are expected to decrease over time with declines in oil production on the North Slope.

Figure 5-5. General Fund Unrestricted Revenue Projections, 1999–2020



Source: ADOR, 1999.

2. Local

Oil and gas activity in areas such as the North Slope and Cook Inlet have provided (or have the potential to provide) additional property tax revenues to the residents of those areas. In particular, most of the activity has occurred in areas such as the North Slope Borough, the Municipality of Anchorage, or the Kenai Peninsula Borough, where there are government entities that can levy property taxes and take advantage of the state's oil and gas tax revenue sharing program.

In comparison, most of the communities in the study area are in an unincorporated area of the state, and none are incorporated individually as municipalities under state law. Royalties, rents, license fees, and other revenues generated by licensing or oil and gas production in the unincorporated portion of the Copper River basin study area will not return directly to the area unless a municipal government entity is established in the unincorporated area. If commercial quantities of oil and gas were discovered in the area, residents in the unincorporated area could form a borough to benefit from potential property tax revenues and state revenue sharing programs.

The western edge of the study area (the unincorporated communities of Nelchina and Lake Louise) is in the Matanuska-Susitna (Mat-Su) Borough. If commercial quantities of oil and gas were discovered in this area, the Mat-Su Borough could receive higher property tax revenues and could also benefit from state revenue sharing.

Oil and gas revenue contributions to the State General Fund are distributed locally through a variety of state programs. These have historically included: revenue sharing to incorporated communities, such as the Mat-Su Borough (Table 5.1); funding of education, health, and public safety programs, and transportation system improvements throughout the study area.

Table 5-1. State Revenue Sharing and Spending in Study Area

Incorporated Area	Amount		
	Revenue Sharing	Other State Spending[a]	Total
Matanuska-Susitna Borough	$521,959	$7,735,029	$8,256,988

Note: State revenue sharing only benefits incorporated communities. Matanuska-Susitna Borough data is included here because a small portion of the Copper River basin is in the Matanuska-Susitna Borough, and would therefore benefit from state revenue-sharing.

a = This figure includes State Safe Communities funds.

Source: ADCRA, 2000.

3. Private Sector

The Copper River basin study area includes private property, the landowners of which could benefit from payments related to production of oil and gas. For example, the regional Alaska Native Claims Settlement Act (ANCSA) for-profit Native Corporation, Ahtna, Inc., Inc. (Ahtna, Inc.), owns a significant amount of land in the study area. Should the Copper River Basin Licensing Program result in exploration and development on state lands, these activities could result in exploration and production on Ahtna, Inc. lands. Ahtna, Inc. could also benefit from royalties, easements, provision of support services, employment, and other development opportunities related to oil and gas.

4. Multiplier Effects in Rural Areas

Economic activity associated with oil and gas exploration, development, and production would increase economic activity in the study area, but benefits to the economies of the local communities would be smaller than for the larger state economy. In rural Alaska communities, where there are typically smaller economies, the income multiplier is smaller than the 1.35 income multiplier for the state (ISER, 1990). A 1989 study of all Native communities in the state for the U.S. Department of Interior, Bureau of Indian Affairs, calculated multipliers for each community. A typical income multiplier for small communities (100 to 300 population) is about 1.15 (ASCG, 1989). This indicates that, for every dollar of income the members of the community receive directly, an additional $0.15 of income is generated through indirect effects.

B. Effects on Municipalities and Communities

The economic activity associated with oil and gas exploration, development, and production in the study area would affect local governments and unincorporated communities. The effects of oil and gas activity on the residents of the Mat-Su Borough would vary in some instances from effects on residents of the

unorganized portion of the area. These differences would be associated primarily with the ability of the Mat-Su Borough to levy taxes, and with the financial benefits (for example, revenue sharing and other transfer programs) enjoyed by local governments. The following subsections describe the effects for employment, population, income, utilities, and other resources.

Table 5.2. Study Area Employment by Sector

Industry	Number of Workers in Copper River Region[1]	Percentage of Total Workers in Copper River Region	Number of Workers in Matanuska-Susitna Borough[2]
Forestry, Fishing, and Farming	86	13.15	494
Mining	2	0.31	884
Construction	74	11.31	1,447
Non-Durable Manufacturing	3	0.46	352
Durable Manufacturing	2	0.31	344
Transportation	20	3.06	1,106
Communication and Utilities	21	3.21	682
Wholesale Trade	6	0.92	370
Retail Trade	132	20.18	2,529
Finance, Insurance, & Real Estate	4	0.61	771
Business and Repair Service	33	5.05	703
Personal Services	6	0.92	397
Entertainment and Recreation	6	0.92	210
Health Services	20	3.06	820
Education Services	90	13.76	1,787
Public Administration	87	13.3	1,721
Other Professional Services	62	9.48	1,097
Total	**654**	**100.00**	**15,714**

[1] Nelchina employment information is not included because it is part of the Matanuska-Susitna Borough. Lower Tonsina information is not available.
[2] Percentages of the total study area work force were not calculated for the Matanuska-Susitna Borough because only a very small portion of the Borough is in the study area.
Source: ADCRA, 1999.

1. Employment

Comparatively few employees in the Copper River basin study area work in jobs directly related to oil and gas exploration activities. However, oil and gas jobs in the area include maintenance, inspection, and other activities related to the Trans Alaska Pipeline System (TAPS), which runs through the area and passes through area communities such as Glennallen. Ahtna, Inc. also generates shareholder employment through support services provided outside the project area. For example, Ahtna Construction performs pipeline maintenance work for the Trans Alaska Pipeline at one of its pump stations and in other areas through contracts and joint ventures. It also does civil construction work (roads), leases construction equipment, and sells gravel products. Ahtna Minerals Company sells gravel, and it negotiates with oil companies and mining companies for exploration and development of Ahtna's resources. Residents of the study area would likely benefit from the development of oil and gas resources in the area through increased job opportunities. Employment by sector

for the communities in the study area is provided in Table 5.2. Employment related to TAPS is included in the Transportation Sector.

2. Population and Income

Significant population changes would more likely be associated with development of any commercially viable deposits that may be discovered. Population and income levels in the study area are summarized in Table 5.3. As with employment, changes in population and income in the study area would depend on the amount of exploration activity and the size of an oil or gas discovery.

Table 5.3 Socioeconomic Indicators for the Study Area

Community	1998 Population	1990 Median Household Income ($)	1990 Unemployment (Percent)	1990 Percent of Population Living Below Poverty Level
Copper River Basin Area				
Chistochina	56	24,167	52	17.7
Chitina	91	13,125	33.3	40.9
Copper Center	525	34,643	0	12.9
Gakona	24	32,500	0	60.0
Glennallen	488	30,833	4.4	8.0
Gulkana	96	38,750	27.3	20.3
Kenny Lake	490	21,786	22.9	24.8
Lower Tonsina	NA	NA	NA	NA
Tazlina	280	45,625	13.2	22.0
Tonsina	44	16,250	0	0
Matanuska-Susitna Borough				
Entire Borough	55,694	40,745	11.6	9.3
Lake Louise	NA	NA	NA	NA
Nelchina	NA	NA	NA	NA

NA=not available. Source: ADCRA, 1999.

Nearly all communities within the proposed study area are linked by the two major highways that traverse the Copper River basin. Electricity is provided by Copper Valley Electric Association, which purchases power from the state-owned Solomon Gulch Hydro Facility, and owns diesel plants in Glennallen and Valdez. Refuse collection services are available from Copper Basin Sanitation, and solid waste is deposited in the Glennallen landfill. Residents of the study area could benefit from a gas finding if the Copper Valley Electric Association could use the resource to generate electricity more economically than current resources allow. Table 5.4 compares prices of electricity for residents of Southcentral Alaska served by different utilities and shows that lower prices are possible.

Currently, oil and gas industry infrastructure is limited to the TAPS corridor. Some use of existing roads and trails may occur. Electric power to support operations may be purchased from the local electric cooperative, if available. However, license-related effects on community infrastructure (public buildings and

services) are expected to be minimal because exploration projects are designed to be stand-alone operations, requiring little or no public resources.

Table 5.4 Southcentral Alaska Residential Utility Costs

Utility Company	Charge to Customer ($)				
	Facility or Customer Charge	Energy Usage Charge (per kWh)	Power Cost Adjustment Charge (per kWh)[a]	Regulatory Charge (per kWh)	Average Bill (month)[b]
Copper Valley Electric Association	12.00	0.08540	0.0677	N/A	93.14
Matanuska Electric Association	5.65	0.09476	(0.00291)	0.000280	54.48
Chugach Electric Association	6.25	0.0900	N/A	N/A	53.95
Municipal Light and Power	6.56	0.08803	(0.00258)	0.000280	52.00

[a] This figure changes quarterly.
[b] Average bills were calculated for each provider by using the average number of kilowatt-hours per month for Municipal Light and Power customers.
KWh=Kilowatt hour. N/A=Not applicable.
Source: CEA, 1999; CVEA, 1999; MEA, 1999; ML&P, 1999.

3. Land Use and Access

a. Land Use Plans

Lands within the study area are owned by the federal and state governments, Ahtna, Inc., and private individuals. The majority of the study area does not lie within the boundaries of any incorporated municipality (city or borough) and is not subject to any municipal land use plans or regulations.

The state of Alaska adopted a Copper River Basin Area Plan (Area Plan) in 1986 in order to classify state lands for management of the following purposes:

- Whether to keep or sell land.
- Open or close areas to mineral entry.
- Recommend areas for legislative designation.
- Set guidelines for use of land.

Licensees must comply with all current or future ADNR area plans and recreation rivers plans; and ADF&G game refuge plans, critical habitat area plans, and sanctuary area plans within which a licensed area is located. See Chapter Seven mitigation measures.

The Mat-Su Borough prepared a general, areawide comprehensive plan in 1970. This plan provides no specific guidance for oil and gas exploration and production activities, and the Borough has been preparing area-specific comprehensive plans to provide more specific land use guidance, plus provide the basis for adopting area-specific zoning regulations. These area-specific plans are prepared after being requested by a

local community. However, no area-specific comprehensive management plans or zoning ordinances have been requested or prepared for portions of the Borough within the study area.

Table 5.5 Heating Methods in Study Area by Community

Community	Residents Using Various Heating Methods (Percent of Population)				
	Electric	Fuel Oil/ Kerosene	Wood	Tank/LP/ Bottled	Piped Gas
Chistochina	0	28.6	71.4	0	0
Chitina	0	21.7	78.3	0	0
Copper Center	5	77.5	11.9	5.6	0
Gakona	0	100	0	0	0
Glennallen	2.4	81.5	11.3	3.6	1.2
Gulkana	0	90.5	7.1	2.4	0
Kenny Lake	0	65.7	34.3	0	0
Lower Tonsina	NA	NA	NA	NA	NA
Tazlina	0	80.5	15.9	3.7	0
Tonsina	0	100	0	0	0
Nelchina	NA	NA	NA	NA	NA

NA=Not available, LP=Liquid propane.
Source:ADCRA, 1999

b. Access

The primary access routes within the study area are the Glenn and Richardson Highways, and their connected road systems. These two state highways provide east west and north south access, respectively. TAPS also traverses the study area roughly parallel to the Richardson Highway.

The Glenn Highway enters the study area just east of Eureka, intersects the Richardson Highway at Glennallen, and continues east as the Tok Cutoff from Gulkana to the northeast corner. The Lake Louise Road provides additional highway access to the northern portion of the area. Several all-terrain vehicle (ATV) trails provide informal access off of the Glenn Highway, and extensive snow machine access occurs during the winter when snow cover is adequate.

The Richardson Highway enters the study area approximately 25 miles south of Paxson, and exits 10 miles north of Tonsina. The Edgerton Highway leaves the Richardson just south of Copper Center and traverses the southeast corner of the study area. As with the Glenn Highway, several ATV and snow machine trails provide informal access off of the Richardson Highway.

Several airstrips are located in the study area, the largest of which is located at Gulkana. Most other communities, such as Glennallen, Copper Center, Kenny Lake, and Lake Louise, also have airstrips. In addition, numerous remote airstrips exist in the area, and could possibly be used in support of exploration activities.

Communities adjacent to exploration activities may experience increased use of transportation systems, such as air charter services, airstrips, or roads, for transportation of personnel or construction equipment. Winter ice and snow roads could be constructed to provide access to more remote areas.

Impacts from oil and gas development to recreational activities can be minimized by appropriate mitigation measures at the permitting stage. Licensees will be required to not restrict public access within the licensed area.

Mitigation Measures

The following are summaries of applicable mitigation measures and licensee advisories that would mitigate potential land use impacts.

- Preserving Access -- No license facilities or operations may be located so as to block public access to or along navigable and public waters as defined in AS 38.05.965(13) and (17). Public access to, or use of, the licensed area may not be restricted except within 1,500 feet or less of drill sites, buildings, and other related structures. Areas of restricted access must be identified in the plan of operations.
- Conflict Resolution -- License related activity will be restricted if the ADNR commissioner determines it is necessary to prevent unreasonable conflicts with local subsistence harvests. Restrictions can include alternative site selection, requiring directional drilling, and seasonal drilling restrictions.
- Community Outreach -- Plans of operation must describe the licensee's efforts to communicate with local communities, and interested local community groups in the development of such plans. Where surface activities are proposed on non state-owned land, licensees must submit a plan of operations to the private surface owner. Lessees must include in their seismic permit applications a plan for notifying the public of their activities.
- Facility Siting - Facilities, other than roads, docks, or pipeline crossings may not be sited within one-half mile of major rivers or within 500 feet of any fishbearing lake. New pipelines must utilize existing transportation corridors and be buried, whenever possible.
- Employee Training - Workers must be educated about the land and its people. The licensee, including any contractors and subcontractors, must train employees about the environmental, social, and cultural values of the people of this area. Employees must understand how to avoid damaging biological and archaeological resources. They should have an increased sensitivity and understanding of community values, customs, and lifestyles of local residents.

C. Steps In Exploration, Development, and Production Phases

Following licensing, there are three primary phases of industrial activity: exploration, development, and production. The development impact on the environment or "footprint" has become smaller since early Alaskan oil development. Advances in technology and innovations, especially in drilling, have resulted in smaller and fewer gravel pads necessary to develop the same size field. Current operations are cleaner as a result of improved waste disposal practices, prompted in part by environmental awareness. Post-licensing activities are presented in Table 5.6.

1. Geophysical Exploration

Geophysical companies usually conduct seismic surveys under contract with license holders. Contracts may have provisions that allow the geophysical company to sell the data to other interested companies.

Geophysical programs may take place before or after a lease sale. If sufficient data are already available, additional seismic data acquisition may not be necessary.

Table 5.6 Post Licensing Exploration, Development, and Production Phase Activities

Exploration	Development	Production
permitting	gravel pits, pads, and roads	well workover (rigs)
water usage	dock & bridge construction	gravel pads and roads
environmental studies	drilling rigs	produced water
seismic tests	pipelines	air emissions
exploratory drilling	work camps	pipeline maintenance
land clearing	permitting	work camps
drilling muds & discharges	monitoring	trucking
gravel road beds	well heads	
work camp	reinjection wells	
increased air traffic		
temporary gravel pads		
permitting		
environmental studies		
research and analysis		

Geophysical exploration activities are regulated by 11 AAC 96, and ADNR tailors each permit approval to the specifics of a proposed project. Restrictions on geophysical exploration permits depend on the duration, location, and intensity of the project. They also depend on the potential effects the activity may have on important species or human use, such as migrating salmon. The extent of effects on important species varies, depending on the survey method and the time of year the operation is conducted.

Exploration activities may include: examination of the surface geology, geophysical survey programs, researching data from existing wells, and/or drilling an exploratory well. Surface analysis includes the study of surface topography or the natural surface features of the area, near-surface structures revealed by examining and mapping exposed rock layers, and geographic features such as hills, mountains, and valleys.

Geophysical surveys help reveal what the subsurface may look like. Before they proceed, companies must acquire one or more permits from the state, depending on the timing and extent of the proposed activity. Companies will either gather two-dimensional (2-D) or three-dimensional (3-D) seismic data. Two-dimensional seismic programs usually have fewer crew members and employ less equipment than 3-D programs.

Land-based seismic surveys are typically conducted in winter and use low ground pressure tracked vehicles or helicopters for remote operations. The method involves sending energy into the earth using an explosive charge or other energy wave-generating device, such as Vibroseis. Vibroseis generates energy waves of continuously varying frequency. Depending on density, waves bounce back from the various rock layers and are received by listening devices called geophones. Impulses are recorded on computer tape, processed on high-speed computers, and displayed in the form of a seismic reflection profile. In another method, explosives are lowered into drill holes and detonated, or they may be suspended on stakes above the ground (Poulter method). The drill holes are drilled with either track-mounted drills or with drills slung into position by helicopters. For 3-D seismic operations, holes are drilled typically 25 feet deep with 5 pounds of explosive set at the base of the hole.

2. Exploratory Drilling

If the geologic studies indicate that oil or gas may be present, licensees may initiate drilling of an exploration well. Drilling is the only way to learn whether commercial quantities of oil or gas are present in subsurface rock formations. Drilling wells is expensive, and exploratory drilling normally happens only after mineral rights have been secured, and after preliminary, less expensive exploration activities, such as seismic surveys, reveal the most likely places to find oil or gas.

Exploratory drilling operations normally occur in winter to minimize impact. Sometimes temporary roads must be built to the area. The drill site is selected to provide access to the prospect to be drilled and, if possible, is located to minimize the surface area that may have to be cleared. A typical drill pad is made of sand and gravel laid over a liner or can be constructed of ice, and is about 300 feet by 320 feet. The pad supports the drill rig, which is brought in and assembled at the site, a fuel storage area (if needed), and a camp for workers. If possible, an operator will use nearby existing facilities for housing and feeding its crew. If the facilities are not available, a temporary camp of trailers on skids may be placed on the pad (Chevron, 1991)

Enough fuel is stored on-site to satisfy the operation's short term needs, which amount to about 4,500 gallons of diesel and gasoline per day. The storage area is a diked gravel pad lined with an 80-mil synthetic membrane. Additional amounts of fuel may be stored at the nearest existing facility for transport to the drilling area as needed (Chevron, 1991).

An exploratory drilling operation generates approximately 12,000 cubic feet of drilling solids. The state discourages the use of reserve pits and most operators store drilling solids and fluids in tanks, or in temporary on-pad storage areas until they can be disposed of, generally down the annulus of the well, in accordance with 20 AAC 25.080. If a reserve pit is necessary, it is constructed off the drill pad and could be as large as 5 feet deep and 40 feet by 60 feet. It is lined with an 80-mil geotextile liner to prevent contamination of surrounding soils. Drilling mud and fluids produced from the well are separated and disposed of, often by reinjection at another facility. With appropriate permits, solids may be left in place in a capped reserved pit. If necessary, a flare pit may be constructed off of the drill pad to allow for the safe venting of natural gas that may be encountered in the well. (Chevron, 1991). If the exploratory well discovers oil or gas, it is likely that the gravel pad used for the exploratory well will also be used for development and production operations.

Exploratory drilling generates more information for the licensee. Drilling operations collect core samples, well logs, cuttings, and various test results. Cores may be cut at various intervals so that geologists and engineers can examine the sequences of rock that are being drilled. Well logs are records of tests conducted by dropping various instruments into the well bore. Cuttings are fragments of rock cut by the drill bit. These fragments are carried up from the drill bit by the fluids pumped into the well (Gerding, 1986; ARCO, Undated)

The drilling process is as follows:

- Special steel pipe, conductor casing, is hammered into the ground.
- The bit rotates on the drill pipe to drill a hole through the subsurface rock formations.
- Blowout preventers are installed on the surface and only removed when the well is plugged and abandoned. Blowout preventers are large, high-strength valves that close hydraulically on the drill pipe to prevent the escape of fluids to the surface or into groundwater formations (ARCO, Undated).
- Progressively smaller sizes of steel pipe, called casing, are pushed into the hole and cemented in place to keep the hole from caving in, to seal off rock formations, and to provide a conduit from the bottom of the hole to the drilling rig.
- The well either produces, is capped, or is plugged and abandoned.

If the exploratory well is successful, the operator will probably drill one or two more to delineate the extent of the discovery and gather more information about the field. The licensee needs to know how much oil and gas may be present, their quality, and the quality of the rocks in which they are found.

3. Development and Production

During the development phase, the operator evaluates the results of exploratory drilling and develops plans to bring a discovery into production. Production operations bring well fluids to the surface and prepare them for transport to the processing plant or refinery. This phase can begin only after exploration has been completed and tests show that the discovery is economically viable. (Gerding, 1986)

After designing the facilities, the operator constructs gravel pads and drills production wells. The operator must build production structures that will last the life of the field and may have to redesign and add new facilities for enhanced recovery operations as production proceeds.

Production operations for natural gas generally consists of:

- Natural gas flows through a high-pressure separator system where any liquids (water, condensate, etc.) are removed. Produced oil goes through a separator to remove the natural gas from the oil.
- The gas is compressed if necessary.
- The gas is dehydrated to lower its water content.
- The gas is then metered (i.e. the amount of gas produced is measured).
- The gas is transported to a facility where it passes through a water precipitator to remove any oil.

Production operations for oil generally consist of:

- Produced crude oil goes through a separator to remove gas from the oil stream
- The oil moves to processing facility via a pipeline.
- The gas removed from the oil may be compressed and reinjected to keep the pressure up in the producing formation and assist in oil production.

The development "footprint" in terms of habitat loss or gravel filling has decreased in size in recent years as advances in drilling technology have led to smaller, more consolidated pad sizes. Longer horizontal departures reduce per acre impacts compared to older field developments. Depending on the depth of the reservoir rock and horizontal deviation ability, the area of surface disturbance per acre of habitat can be minimized. A single production pad and several directionally drilled wells can develop more than one, and possibly several, 640-acre sections. Based on current development practices, surface impact from developing tracts is unlikely to exceed 1.9 percent per 640-acre section for any given development on leased and developed acreage.

D. Cumulative Effects

1. Effects on Fish and Wildlife Habitats, Populations, and Uses

The following sections describe the reasonably foreseeable cumulative effects of potential oil and gas exploration and development on fish and wildlife and their habitats within the Copper River basin study area. Possible adverse impacts of oil and gas activity include: loss of fish and wildlife habitat; environmental degradation; and restriction of access for trapping, sport hunting and fishing, and subsistence use. There are no marine or estuarine habitats within the study area.

a. Effects on Vegetation and Wetlands

Exploration and development activities within the study area are likely to involve some clearing and grubbing of vegetation, especially in upland portions of the study area. Clearing involves chipping the vegetation or felling and removing trees and undergrowth from an area. Grubbing involves removal of roots and other vegetation within the same area. The Director of the Alaska Division of Oil and Gas (DO&G) must approve any clearing and grubbing for exploration or development. Disturbed areas would likely be revegetated following construction, or allowed to regenerate naturally. However, slash resulting from clearing and grubbing of vegetation must be disposed of in an appropriate manner to reduce the risks of infestation and disease.

The spruce bark beetle (*Dendroctonus rufipennis Kirby*) infestation has become an epidemic throughout southcentral Alaska, and has been a historic problem in the Copper River basin. Potential effects to the ecosystem within the upland portions of the study area may result during construction activities associated with access roads, seismic trails, and drill pads that result in piles of logs and slash. If not properly disposed of, the downed trees could serve to accelerate spruce bark beetle and other insect and disease infestations. DO&G routinely considers any clearing proposed at the plan of operations phase and tailors measures to prevent the spread of spruce bark beetles and forest fires.

Although every effort will be made to avoid impacting wetlands during exploration and development within the study area, it may become necessary to develop some wetlands. The discharge of dredge or fill material affecting wetlands requires a Section 404 permit from the U.S. Army Corps of Engineers and, depending on the activity, may also require additional action from the U.S. Environmental Protection Agency, State Division of Governmental Coordination, and the Alaska Department of Environmental Conservation. For further discussion of cumulative effects on wetlands and appropriate mitigation measures, see Parts a, c, d and e of this section.

b. Effects on Fish

Several species of anadromous and resident fish species use the rivers within the Copper River basin watershed for spawning, overwintering, and as migratory corridors. Use patterns vary by species and within species by life stage. Potential impacts are discussed below.

Habitat Loss: Most exploration activity occurs during the winter months to minimize damage to the environment. The construction of ice roads and clearing of vegetation during ice road or pipeline construction would involve use of heavy equipment and, in areas where equipment must cross streams, degradation of the steam banks could occur. Damage to stream banks could lead to erosion the following season, which could affect adjacent fish habitat through siltation of the streambeds. During the open water period, protecting the integrity of stream bank vegetation and minimizing erosion are important elements in preserving fish habitat (ADNR, 1995). To maintain fish habitat and populations within the study area, the use of heavy equipment within riparian habitat will be prohibited and bridges or non-bottom-founded structures will be required for crossing streams.

Withdrawal of water from lakes and ponds for ice road construction could affect fish overwintering habitat by entraining juvenile fish, lowering water levels, and increased disturbance. The construction of ice roads across rivers and streams may also affect the ability of fish to reach overwintering areas by blocking movement under the ice and causing direct loss of overwintering habitat. Blockage of movement could also occur from improper installation of culverts in streams for permanent roads. Mitigation measures to protect fish and overwintering areas from damage due to ice road construction include: obtaining written permission from ADF&G before removing water from fish-bearing waterbodies, limiting flow of and screening water intake pipes from fish-bearing waterbodies to prevent fish entrapment, and prohibiting compaction or removal of snow over fish-bearing streams.

During oil and gas related development, gravel removal from fish-bearing streams to support oil and gas activities could adversely impact the habitat in these streams and the fish they support. Gravel removal could increase sediment loads, change the stream bed course, cause instability upstream, destroy spawning habitat, and create obstacles to fish migration (ADNR, 1995). To prevent harm to fish habitat, gravel mining within an active floodplain will be prohibited under the proposed mitigation measures.

Seismic Activities: Seismic activities are typically conducted during the winter months using truck-mounted vibrators as an alternative to high explosives to minimize the effect on the environment. Seismic operations using high explosive could cause direct injury to fish resources in lakes and streams (ADF&G, 1996; Fink - Pers. comm, 1999b). Pressure waves from high explosives can potentially kill and injure fish near the explosion but the impulses would dissipate to a non-lethal level within a short distance (less than 328 feet) (MMS, 1996). Overpressures of 30-40 pounds per square inch (psi) will kill fish with swim bladders, and 3 to 4 psi can kill juvenile salmonids (Fink - Pers. comm, 1999b). Shock waves from explosions can also shock and jar fish eggs at sensitive stages of development. These types of impacts are mitigated by restricting the use of explosives in close proximity to fish-bearing lakes and streams. Mitigation measures to protect fish eggs may include limiting the timing of seismic work and are considered by DO&G on a case-by-case basis as a condition for obtaining a geophysical exploration permit. Other restrictions include requiring that seismic activities be set back far enough from freshwater fish spawning areas that shock waves are reduced to safe levels before reaching incubating eggs during sensitive stages of development (Fink - Pers. comm, 1999b).

Oil Spills: Oil spills within the study area could range from small, chronic leaks from equipment or facilities to catastrophic pipeline failures or drilling blowouts. The effects of oil spills on fish in the study area

would depend on many factors, including the time of year, size of the spill, and the waterbody affected. Potential adverse effects from an oil spill could include direct mortality from oiling of the gills, mortality of prey species, mortality from consumption of contaminated prey, and blockage of movement or displacement from important habitats. Mortality of egg and larva could occur in spawning or nursery areas from the toxic effects of the oil. Sub-lethal effects may also reduce fitness and affect the ability to endure environmental stress. Effects of oil spills during the winter would be expected to be negligible, but could potentially be major during the open water season, depending on the site-specific conditions. Proposed mitigation measures to protect fish and eggs from an oil spill include: siting facilities away from fish-bearing streams and lakes, development of oil spill contingency plans, and providing adequate spill response training.

Mitigation Measures

The following are summaries of some applicable measures that would mitigate potential impacts to fish. For a complete, full text listing of mitigation measures, see Chapter Seven. Title 16 of the Alaska Statutes requires protection of documented fish-bearing streams from disturbances associated with development.

- Protection From Drilling and Production Discharges - Licensees must use appropriate methods for disposal of muds, cuttings, and produced waters.
- Protection of Fish Habitat, Including Fish Overwintering Areas - Licensees must avoid altering stream banks and obtain approval for the location of fish stream crossings. Licensees might be required to construct ice or snow bridges if ice thickness at a crossing is insufficient to protect the streambed and the stream bank. Licensees must not operate equipment (except boats) in open water areas of rivers and streams. When a fish-bearing waterbody is used as a water source, Licensees must use appropriate measures to avoid entrainment of fish. Permanent facilities must be sited away from fish-bearing streams and lakes.
- Protection From Seismic Activities - Licensees must follow requirements for explosives during onshore seismic activities, and are prohibited from using explosives in open water areas of fish-bearing streams and lakes.
- Oil Spill Prevention and Control - Licensees must prepare contingency plans addressing prevention, detection, and cleanup of oil spills. Lining, diking, and buffer zones are required to separate oil storage facilities from aquatic habitats.

c. Effects on Birds

The Copper River basin provides critical habitat for numerous species of birds (Chapter Three). Effects of industrial activities on birds depend on the individual species, time of the year, age or reproductive state of the birds, and type of activity. Potential effects in the study area are more likely to occur after the exploration phase, as few resident species are present during winter when most of the exploration would occur. Effects would depend on: distance from the disturbance; type, intensity, and duration of the disturbance; and other factors (MMS, 1996). Cumulative adverse effects on birds from oil and gas activities could result from: direct habitat loss, barriers to movement, collision with structures, noise and disturbance during nesting and brood rearing, and oil pollution of the terrestrial and aquatic environments.

Habitat Loss: Direct habitat loss could occur from clearing vegetation or filling wetlands for facilities such as drill pads, roads, and oil storage facilities. These facilities could eliminate or alter some preferred bird habitats such as wetlands. Some loss of habitat could also occur from building ice roads for winter exploration, but this would generally be temporary. Breeding birds that occupy areas to be developed would be displaced to suitable habitats in adjacent areas. The effects on local populations of terrestrial birds in the study area due to

the loss of small amounts of habitat from roads and pads would not be expected to adversely affect any of the local bird populations, considering the amount of habitat available.

To mitigate the impacts to birds from habitat loss, licensees must identify and avoid sensitive habitats and locate facilities outside of key wetlands. Permanent facilities must be sited at a minimum distance (500 feet to one-half mile from rivers) from streams and waterbodies to minimize effects on waterbirds. Surface entry near trumpeter swan nesting areas will be prohibited during the summer months, and permanent facilities will not be permitted within one-quarter mile in these areas to avoid displacement of swans. Facility siting will be prohibited within one-mile of peregrine falcon nest sites.

Noise and Disturbance: Noise and disturbance that may affect birds includes: seismic surveys (surface explosions), construction of roads and pads, vehicle traffic, aircraft overflights, and drilling and production activities. Responses of birds to human disturbances (including aircraft) are highly variable and depend on: the species; the physiological or reproductive state of the birds; distance from the disturbance; type, intensity, and duration of the disturbance; and many other factors.

Repeated low-level aircraft overflights could cause some nesting birds to flush and expose eggs to chilling or predation. Altitude restrictions on aircraft help to minimize this impact. Aircraft overflights could also cause disturbance of concentrations of feeding, molting, or staging waterfowl in lakes and other wetlands, which might reduce the ability of these birds to acquire the energy necessary for successful migration. If such disturbances occurred frequently, it potentially could affect migration, mortality, and winter survival of affected birds (MMS, 1995b). In the Copper River basin, waterfowl are generally dispersed over a large area, but a few concentration areas have been identified in the study area. Aircraft will be required to maintain a minimum altitude of 1,500 feet above ground level within the study area at those times of the year when waterfowl are present, except during takeoff and landing. Thus, effects of noise and disturbance from aircraft overflight on waterfowl would have minimal adverse affects on local populations.

The Copper River basin has been identified as a major trumpeter swan nesting area (Chapter Three). Trumpeter swans are believed to be sensitive to human disturbance on their breeding grounds. Intrusions by humans on nesting grounds have caused temporary and permanent abandonment, as well as movement from breeding or staging areas (Banko, 1960; Bangs et al., 1982; Belanger and Bedard, 1989). Henson and Grant (1991) studied the effects of human disturbance on Trumpeter Swans in the Copper River basin. The results indicated that regular aircraft overflight and passing road traffic did not cause incubating females to leave the nest. Swans were more sensitive to the noise and visible presence of stopped vehicles, pedestrians, and researchers. Such disturbances lead to frequent absences by incubating females, uncharacteristic brood movement, and significant behavioral changes. These responses could lead to a decrease in productivity due to increased egg and hatchling mortality, plus additional stress on the already energetically-stressed females. To minimize impacts to trumpeter swans from disturbance, aircraft overflights would be restricted to minimum altitude of 1,500 ft. when in the vicinity of nesting swans.

Noise and disturbance can affect the nesting success of bald eagles. Minimum distances will be maintained from oil and gas facilities and activities according to the guidelines of the Bald Eagle Protection Act.

Oil Spills: Prevention of and responsive countermeasures to oil spills are particularly critical to assure protection of birds. Direct oil contact is often fatal and oil spills in aquatic environments can results in substantial mortality to birds. Oiling of birds causes death from hypothermia, shock, or drowning. The direct effect of oil on a bird is to clog the fine structure of its feathers, which are responsible for maintaining water-repellence and providing heat insulation. The loss of thermal insulation, especially in cold climates, results in greatly increased metabolic activity to maintain body temperature. Birds also ingest oil in attempting to preen oil from their plumage (NRC, 1985). Some species (e.g., harlequins) can also ingest oil by eating oiled prey

(EVOS, 1996). Relatively small amounts of ingested oil can cause a temporary depression of egg laying and reduce the hatching success of those eggs that are laid. Oil deposited on eggs from the feathers of the adults can also have an adverse impact on hatching, even in small quantities (ADF&G, 1998). The birds most susceptible to oiling are those which are gregarious, spend most of their time on the water, and dive rather than fly up when disturbed (NRC, 1985).

Bald eagles may encounter floating oil while preying on fish and oil-contaminated carcasses. Oil is also ingested through preening and can be taken back to the nest to oil eggs and young. Surveys taken in 1989 following the Exxon Valdez Oil Spill (EVOS) indicated that nest failure was 85 percent in oiled areas, compared to 55 percent in lightly oiled or unoiled areas. In 1990, increases in bald eagle breeding success suggested that the setback to eagle reproduction was temporary. Researchers estimate that the bald eagle population had nearly recovered by 1994 (EVOS, 1994), and an aerial survey of adults in 1995 indicated that the population had returned or exceeded its pre-spill level in Prince William Sound (EVOS, 1996).

The number of birds impacted by a spill would depend on the time of year, the extent of the spill, the size of the aquatic habitat affected, and the density of local bird populations.

If oil development occurs, some alteration of bird habitat and disturbance of birds present during oil-related activities can be expected. However, with state and federal government oversight, and implementation of applicable mitigation measures, any oil spill cleanup activities within the study area should not prevent overall bird population levels from remaining at or near current levels.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories that would mitigate potential impacts to birds from potential oil and gas activities in the study area. For a complete listing of mitigation measures and advisories, see Chapter Seven.

- Habitat Loss Avoidance - Licensee must identify and avoid sensitive habitat areas and site facilities outside of key wetlands. Facilities must be sited at least 500 ft. from streams and waterbodies.
- Nesting Area Avoidance - Should development occur in an area where nesting Trumpeter Swans are present, surface entry would be prohibited in the summer months and, the siting of permanent facilities, and aircraft overflights would be prohibited in the vicinity of the nesting sites.
- Bald Eagle Protection - Licensee must comply with the guidelines of the Bald Eagle Act of 1940, as amended.
- Oil Spill Prevention and Control - Licensees must prepare contingency plans addressing prevention, detection, and cleanup of oil spills. Lining, diking, and buffer zones are required to separate oil storage facilities from aquatic habitats.

d. Moose

Moose are present throughout the Copper River basin study area. Calving and wintering habitat are considered particularly critical. Lowlands support relatively high concentrations of calving moose, and riparian habitat along river drainages constitute essential moose wintering range.

Habitat Loss: Vegetation clearing and construction of roads and pads in the study area could result in a direct loss of some moose habitat. Loss of winter habitat along riparian habitats would be the most important to local moose populations. Some habitat loss would also occur from the displacement of animals around oil field facilities due to noise and activity. Moose movement to critical areas, such as wintering areas, would not be expected to be adversely affected.

It is likely that oil and gas exploration and development would result in some increase in habitat loss beyond that which is already occurring due to other development. However, given the amount of overwintering and calving habitat in the Copper River basin, impacts to moose populations are expected to be minimal.

Noise and Disturbance: Noise and disturbance that might affect moose include: seismic surveys; construction of facilities such as roads, pads, and pipelines; vehicle traffic; aircraft overflights; and drilling and production activities. Increased roads and vehicle traffic would also result in increased mortality from collisions. Increased disturbance during the winter months could result in increased energy expenditures and reduce reserves needed to survival. Impacts to moose can be reduced by avoiding winter moose concentration areas. Moose can adapt to certain levels of activity over time, and the overall effects of increased noise and disturbance are not expected to adversely affect local moose populations.

Oil Spills: Oil spills in the study area would not be expected to affect more than individual animals, localized habitat or, potentially, some food sources. Some oil could be ingested through eating contaminated foods or ingestion through grooming. However, with state and federal government oversight, and implementation of applicable mitigation measures, the effect of oil spills would be expected to be negligible to the moose population in the study area.

e. Caribou

The study area is within the range of the Nelchina Caribou Herd, although calving mainly takes place west of the area.

Habitat Loss: There would be some loss of caribou habitat from vegetation clearing and filling for construction of facilities, roads, pads, and pipelines. The actual area lost to these types of development would be small in comparison to the large amount of habitat in the study area. Direct loss of calving habitat would have the greatest effect on the Nelchina Herd, but this could be mitigated through avoidance of documented calving areas to ensure that facility siting and activities minimize impacts.

Oil and gas exploration and development may lead to new road construction and, depending on location relative to caribou use areas, these roads may provide greater access for caribou hunting and greater harvest of animals, thus affecting management of the herd.

Noise and Disturbance: The primary sources of disturbance from oil and gas development would be from aircraft overflights, ground-vehicle traffic, noise from drilling activities, and the presence of humans near cows with new calves (ADNR, 1995). Caribou cow and calf groups are most sensitive to human disturbance during the post-calving period. There is a documented avoidance of roads and facilities by cow-calf pairs in the Prudhoe Bay area (Curatolo and Murphy, 1986). Avoidance can result in a barrier to caribou movement and reduce the amount of habitat available for feeding and other essential activities. Exploration and development activities may be restricted in important caribou wintering areas.

Above-ground pipelines could also create disturbance to caribou and potentially result in barrier to movement. Wherever possible, pipelines must utilize existing transportation corridors and, if conditions permit, be buried. Proper installation of elevated pipelines, 5 feet above ground level, has been shown to mitigate potential blockage to animal movement (Cronin et al., 1994).

Overall, implementing mitigation measures will substantially reduce the effects of noise and disturbance from oil and gas development on caribou, and impacts to the population are expected to be minor.

Oil Spills: In general, the effects of oil spills on caribou would result from oil contamination of individual animals, habitat contamination, and contamination of some local food sources (MMS, 1995a). However, with state and federal government oversight, and implementation of applicable mitigation measures, regional caribou populations are not expected to be affected by oil spills.

f. Bears

Both black and brown bears inhabit the study area and are concentrated along salmon streams in late summer and fall. Both species could potentially be adversely affected by oil and gas activities.

Habitat Loss: Exploration and development activities could result in direct habitat loss from construction of roads and oil-related facilities, and subsequent fragmentation of habitat. The availability of protective cover is considered important in how brown bears are influenced by human activities. Brown bears are at least twice as likely to be displaced from an area where they can see or be seen (ADF&G, 1998). Most of the major salmon stream systems are important to Copper River basin brown bears, and portions of identified movement corridors are included in the study area. Brown bears require large blocks of wilderness habitat and travel corridors connecting them. These movement corridors provide secure cover so bears can safely travel to and from important habitats. Oil and gas activities can affect individual bears by increasing their disturbance responses or displacing them from the critical habitat. Mitigation measures encourage bear interaction plans.

Avoidance of important salmon streams when fish are present would minimize the displacement of bears from this critical habitat. Mitigation measures prohibit the siting of facilities within 500 feet of alll fishbearing streams and lakes.

Noise and Disturbance: Bears may be subject to disturbance from oil and gas activity. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft overflights. Seismic activity that occurs in winter may disturb denning brown bears up to 1.2 miles from the activity, based on movement recorded from radio-collared bears in their dens (USFWS, 1987). Two incidents in 1998 involving seismic crews on the Kenai Peninsula walking in close proximity to brown bear dens resulted in den abandonment. In one of the incidents, the seismic worker was fatally mauled (Fink - Pers. comm., 1999a). Avoidance of known denning sites by at least one-half mile would reduce the chance of disturbance to denning bears.

Road Development: The greatest concern regarding bear populations is road development (ADOF, 1997). Road development increases opportunities for bear-human interactions and reduces the value of the bear habitat. New roads could increase mortality rates through increased bear/human encounters. Roads also increase human access to bear habitat for both legal and illegal hunting (ADF&G, 1998).

Bear/Human Interactions: During exploration, development, and operation, human activity may attract foraging bears, especially to refuse disposal areas. Both black and brown bears are attracted to food and garbage associated with human activity, and may become conditioned to non-natural food sources (Baker, 1987). The conditioning of bears to human food sources may pose a safety threat and the potential need to destroy "problem" animals (ADF&G, 1998). Increased bear/human interactions due to encroachment into bear habitat can also lead to increases in killing bears in defense of life and property. Implementation of bear interaction plans and field personnel training would minimize conflicts between bears and humans.

Oil Spills: Oil spills can affect bears by direct contact, ingesting oil from grooming, eating oiled prey items, and displacement from critical areas as a result of oil spill response activity. Individual bears could be affected by a oil spill; however, with state and federal government oversight, and implementation of applicable mitigation measures, impacts to the Copper River basin bear populations would not be expected.

Overall effects of oil and gas activities on brown and black bears in the Copper River basin would relate primarily to the disturbance to bears and some increased mortality from bear/human encounters. While individual bears might be impacted, there would most likely not be any adverse effects to the regional brown or black bear populations.

g. Effects on Furbearers and Other Small Mammals

Numerous species of furbearers are found in the study area, including: wolf, lynx, wolverine, red fox, ermine, mink, river otter, martin, beaver, snowshoe hare, and muskrat, among others.

Habitat Loss: The effects of direct habitat loss on these species would be negligible. The abundance of wolves and other predators in the study area is ultimately determined by the availability of prey and game management re-location efforts. The ability of adults to provide food is the key determinant in survival of the young. Reduction in prey species would reduce predator populations (USFWS, 1987).

Noise and Disturbance: Most of these species are unlikely to be adversely affected by development within the study area. Primary sources of disturbance are seismic activities and aircraft overflights. Helicopters generally invoke a stronger response from wolves and other predators than fixed-wing aircraft. Ice roads connecting well sites and supply areas would provide a source of vehicle disturbance. Impacts of seismic exploration and drilling on these species are unknown (USFWS, 1986), although they are likely to result in some temporary disturbance in the vicinity of these activities.

Attraction of animals to garbage and other waste can also result in adverse impacts to individual animals. Proper disposal methods would minimize attraction of foxes and other small mammals. See mitigation measures in Chapter Seven.

Oil Spills: The general effects of an oil spill on these species would be similar to that of other terrestrial animals. The potential effects of oil spills include contamination of individual animals, contamination of habitats, and contamination of some local food sources. Predators, particularly foxes, may be attracted to dead oiled-wildlife at a spill site. Foxes and coyotes may be attracted to the human activity at a spill site by the possibility of finding food or garbage. In the event of a large oil spill contacting and extensively oiling habitats in wolf or fox concentration areas, the presence of humans, along with vehicle and aircraft traffic, are expected to cause disturbance and displacement of these animals during cleanup operations. However, with state and federal government oversight, and implementation of applicable mitigation measures, impacts to populations of these species in the study area are expected to be minimal.

Mitigation Measures

The following are summaries of some applicable mitigation measures and advisories that would mitigate potential impacts to terrestrial mammals. For a complete listing of mitigation measures and advisories, see Chapter Seven.

- Habitat Loss Avoidance - Exploration activities must be supported by air service, existing road systems, temporary roads, or by vehicles which do not cause significant damage to the ground surface or vegetation. Construction of permanent roads for exploration in most instances is prohibited, and use of

gravel filling for exploration is discouraged. Facilities must be sited at least 500 ft. from fishbearing streams and lakes.

- Pipeline Siting - Whenever possible, onshore pipelines must utilize existing transportation corridors and be buried where soil and geophysical conditions permit.
- Exploration Facilities Siting - These facilities must be consolidated, temporary, and not constructed of gravel, in order to minimize habitat loss and creation of new, permanent access.
- Waste Management - Licensees must use appropriate methods of garbage and putrescible waste disposal to minimize attracting foxes, bears, and other mammals.
- Oil Spill Prevention - Licensees are required to implement oil spill prevention, control, and countermeasures plans. In addition, they are required to: site facilities away from lakes, streams, and critical wetlands; provide adequate protection for onsite oil storage; and locate pipelines to facilitate oil spill cleanup.
- Disturbance - For projects in close proximity to areas frequented by bears, Licensees are encouraged to prepare and implement bear interaction plans. Operations can be designed to minimize conflicts between bears and humans and minimize attraction of bears to facilities and work camps.
- Den Site Protection - Before fieldwork can begin, known locations of bear den sites must be identified and avoided by one-half mile during denning season. If new dens are encountered in the field, they must be immediately reported to ADF&G.
- Seasonal Restrictions - Seasonal restrictions may be imposed on activities located in important moose calving and caribou wintering areas.

2. Effects on Subsistence Uses

a. Potential Effects

The subsistence resources of the Copper River basin study area represent a significant value to the customary and traditional way of life, as well as income and personal enjoyment, for the residents of the area. Subsistence includes the social activities of consuming, sharing, trading and giving, cooperating, teaching, and celebration among members of the community. Of major concern from a subsistence standpoint are the big game mammals, particularly caribou, moose, and bear. Birds and small mammals, particularly ducks, geese, grouse, hares, and ptarmigan, are also important. Furbearers provide a cash income and raw materials, particularly lynx, martin, wolf, wolverine, beaver, muskrat, and weasel. Fish are important food for humans and dogs, particularly salmon (sockeye, coho, and chinook), lake trout, and grayling. The collection of berries, edible plants, and wood, and the production of crafts and tools made from these wild resources, are also of great value.

Community well being depends on the continued use of subsistence resources because they are culturally and economically significant. The subsistence way of life, with its associated values of sharing food and its influence on the extended family and traditional knowledge, is considered an integral part of being a Copper River area resident (Ahtna, Inc., 1973). In addition to this cultural component, subsistence is a direct source of economic well being for area residents. Subsistence resources enter into household income as a food source that does not have to be purchased. A loss of subsistence resources would represent a loss of income for the entire community (Stickney and Cunningham, 1979; Fall - Pers. comm., 1999).

Reasonably foreseeable indirect effects of oil and gas development on subsistence uses may include: increased access to limited resources by competing users, land use limitations and restrictions on access to subsistence, and the immediate effects of oil spills. Any reduction in local fish and wildlife populations due to

development could result in increased travel distance and hunting time required to harvest resources, potential reductions in harvest success rates, and increased competition for nearby subsistence resources. Potential indirect, beneficial impacts of oil and gas development related to subsistence includes a potential increase in wage earning opportunities to supplement subsistence activities.

Another concern to local residents would be the adverse effects of an oil spill on fish. Fish, such as salmon, trout, or grayling, present in portions of the study area could be affected by excessive disturbances from some oil and gas activities. Fishery resources could be directly damaged, or made less accessible to subsistence fishers. Contingency plans are required for all operations to insure quick response and cleanup of any spilled oil.

As development-related facilities increase, areas could be closed to public access, reducing the area available for subsistence activities, although restricted access must be justified in the plan of operation. If subsistence hunters are displaced from traditional hunting areas, they might have to travel greater distances and spend more time harvesting resources. At the same time, increased public access to hunting, fishing, and trapping areas, due to construction of new roads, could increase competition between user groups for subsistence resources. If competition for scarce resources, like moose, in the Copper River basin were to increase, game managers could restrict non-subsistence hunting and fishing. Management practices to restrict non-local resident hunting are in place for Game Management Unit 13. Licensees are required to cooperate with agencies and the public to minimize disruption of subsistence activities. See Chapter Four for a description of sport hunting and fishing in the study area.

The development of more transportation corridors in support of oil development in the study area could increase human access to the Nelchina Caribou Herd, which could result in increased hunting pressure. Noise and disturbance associated with oil and gas exploration, development, and production are not expected have any significant effects on caribou movements within the study area. Caribou continue to cross roads and highways, even when subject to heavy hunting pressure and increased noise associated with hunting (MMS, 1995a). However, development of roads and pipelines associated with oil production in the study area could affect subsistence. If a road adjacent to a pipeline was heavily traveled (as in during a project's construction phase), caribou may avoid the area of higher vehicular activity. The result could be that a subsistence hunter might have to travel farther from the community in order to take caribou.

Impacts on subsistence from oil and gas exploration, development, production, and transportation depend on proposed mitigation measures, operator and licensee company policies, and applicable wildlife conservation and protection laws. All plans of operations proposals (approval of which is required before any exploration or development activity can begin) are reviewed for consistency with applicable laws, including the local government management plans. The study area is outside all Alaska Coastal Management Plan (ACMP) boundaries, and is not subject to district and ACMP guidelines on subsistence. Similarly, the Matanuska-Susitna Borough Comprehensive Plan does not have any policies on subsistence.

Mitigation Measures

Reducing impacts to subsistence resources from oil and gas development is a primary consideration in planning for an exploratory license. Any activity that has the potential to harm fish or wildlife has the potential to affect subsistence. Mitigation measures have been designed to avoid, reduce, or minimize biological alterations to the study area. All or some of these measures may be required for any operation.

The following summarizes some applicable mitigation measures and licensee advisories that are used to mitigate potential impacts to resources and subsistence uses. Additional, site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Unrestricted Access - Restriction of public access to, or use of, the licensing area due to oil and gas activity is not permitted, except within the immediate vicinity of drill sites, buildings, and other facilities. Any area of restricted access must be justified in the plan of operations.
- Oil Spill Prevention and Response - Contingency Plans are required for all operations addressing the prevention, detection, and cleanup, of releases of oil. They require facilities to be located away from lakes, streams, and critical wetlands to protect from oil stored onsite and pipelines to be located to facilitate oil spill cleanup. In addition, Contingency Plans must include: methods for detecting, responding to, and controlling blowouts; location and identification of oil spill cleanup equipment; location and availability of suitable alternative drilling equipment; and a plan of operations to mobilize and drill a relief well.
- Site Access - Construction of permanent roads is prohibited during the exploration phase.
- Harvest Conflict Resolution - Licensees are required to cooperate with agencies and the public to avoid conflicts by selecting alternative sites or implementing seasonal restrictions on certain activities, and by siting permanent facilities at least 1/2 mile from major from rivers, and at least 500 ft. from fishbearing lakes.
- Community Participation - Residents can provide critical input and traditional knowledge for operations and oil spill prevention and response plans. Plans of operation submitted for review and approval must describe the licensee's efforts to communicate with local communities, and interested local community groups, if any, in the development of such plans.

3. Effects on Cultural and Historic Uses

a. Resources and Regulatory Framework

Cultural and historic resources are those sites and artifacts having significance to the culture of the people within the Copper River basin. ADNR, Office of History and Archaeology, maintains an inventory of cultural resources, including objects, structures, buildings, sites, districts, and travel ways within the region through the Alaska Heritage Resources Survey. Historical and cultural resources identified in the study area include: isolated Native villages and gravesites, cabins, fish camps, mine sites, and transportation and mining-related sites. Information regarding important cultural and historic sites can be obtained by contacting ADNR, Office of History and Archaeology. Ahtna, Inc. is a major landowner within the region and has a vested interest in resource site protection within the study area. Ahtna maintains a separate record of cultural resource sites within the region and should be contacted prior to initiation of any exploration (Bittner - Pers. comm., 1999).

ADNR, Office of History and Archaeology has researched available sources and found 300 known historic and archaeological sites within the study area. The majority of the reported sites within the area exist along the Copper River, its tributaries, and the lakes of the region. The setting of the area, however, suggests a high potential for the discovery of additional sites (Bittner - Pers. comm., 1999).

State policy on these resources is reflected in AS 41.35.010: "It is the policy of the state to preserve and protect the historic, prehistoric and archaeological resources of Alaska from loss, desecration and destruction … ." Existing statutes, which apply to both known sites and newly discovered sites, are:

- AS 41.35.200(a) prohibits a person from unlawfully appropriating, excavating, removing, injuring or destroying any historic, prehistoric, or archaeological resources of the state. "Historic, prehistoric, or archaeological resources" include" deposits, structures, ruins, sites, buildings, graves, artifacts, fossils, or other objects of antiquity which provide information pertaining to the historical or prehistorical culture of

people in the state as well as to the natural history of the state." AS 41.35.230(l). Violators of this statute are subject to criminal (misdemeanor) penalties and civil penalties (fines up to $100,000 per violation) AS 41.35.210, 215.

- AS 41.35.200(c) prohibits the unlawful destruction, mutilation, defacement, injury to, removal of or excavation of a grave site, tomb, monument, gravestone, or other structure or object at a grave site, even if the grave site appears to be abandoned, lost, or neglected. Violators of this statute are subject to the same penalties listed above for AS 41.35.200(a) [historic, prehistoric and archaeological resources].

b. Potential Impacts

Naturally occurring impacts to cultural resources within the region result from earthquakes, treefalls, stream erosion, and other erosive processes. Potential impacts to these resources from oil and gas exploration and development could occur during the exploration, development, or production phases, but are more likely to occur during oil and gas development activities. Impacts include disruption of culture and disturbance of historic and archaeological sites.

Prehistoric and historic archaeological resources could be affected by activities associated with installation and operation of oil and gas facilities, including: drill pads, roads, airstrips, pipelines, processing facilities, and any other ground-disturbing activities. Damage to archaeological sites can include: direct breakage of cultural objects; damage to vegetation and the soil thermal regime, leading to erosion and deterioration of organic sites; and shifting or mixing of components in sites resulting in loss of association between objects. Crews at archaeological or historic sites could also damage or destroy sites by collecting artifacts (USFWS, 1986).

Oil Spills: Oil spills can have an indirect affect on archaeological sites by contamination of organic material, which would eliminate the possibility of using carbon dating methods (USFWS, 1986). The most important understanding obtained from past, large-scale oil spill cleanups is that archaeological resources generally were not directly affected by the spilled oil. Following EVOS, the greatest effects came from vandalism, because more people knew about the locations of these resources and were present at the sites. The detrimental effects of cleanup activity on these resources during EVOS were minor because the work plan for cleanup was constantly reviewed, and cleanup techniques were changed as needed to protect archaeological and cultural resources (Bittner, 1993). Various mitigation measures used to protect archaeological sites during oil-spill cleanups include: avoidance (preferred), site consultation and inspection, onsite monitoring, site mapping, artifact collection, and cultural resource awareness programs.

Cumulative effects on archaeological sites from oil and gas exploration, development, and production are expected to be low. In the event than an increased amount of ground-disturbing activity takes place, state and federal laws and regulations should mitigate effects to archaeological resources. The expected effects on archaeological resources from an oil spill are uncertain, but data from EVOS indicated that less than 3 percent of the resources within a spill area would be significantly affected (MMS, 1998).

Well Blowout or Explosion: Disturbance to historical and archaeological sites might occur as a result of activity associated with accidents such as an oil or gas well blowout or explosion. Archaeological resources in the immediate vicinity of the blowout might be destroyed, and cleanup activities could result in disturbance by workers in the vicinity of the accident site.

Mitigation Measures

The following are summaries of some applicable mitigation measures and advisories designed to mitigate potential impacts to cultural resources.

- Education - Licensees are required to conduct training for all employees and contractors on environmental, social, and cultural concerns in the area of activity.
- Protection of Historic and Archaeological Sites - Prior to exploration activities involving ground disturbance, and subsequent development, Licensees must conduct an archaeological inventory. If any objects are discovered at any time, they must be reported, and appropriate protective measures followed.

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